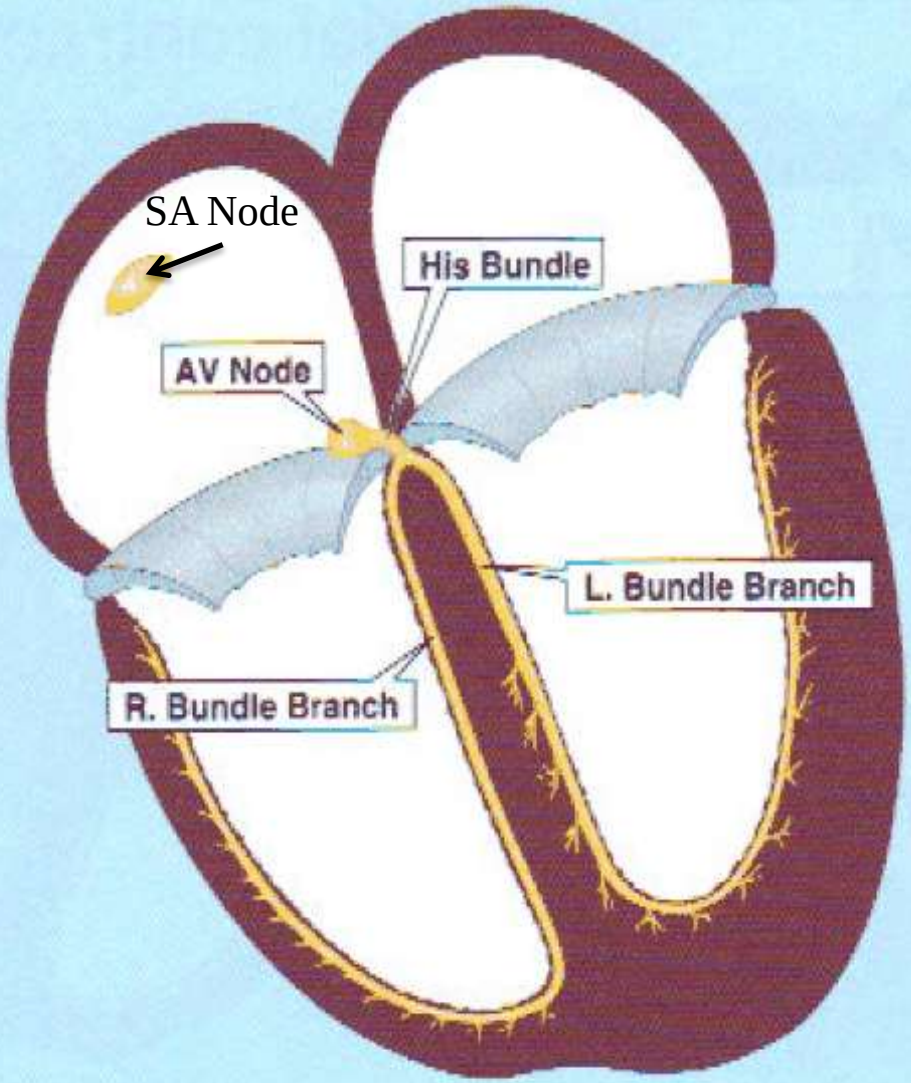
U.S. Army School of Aviation Medicine

EKG Interpretation

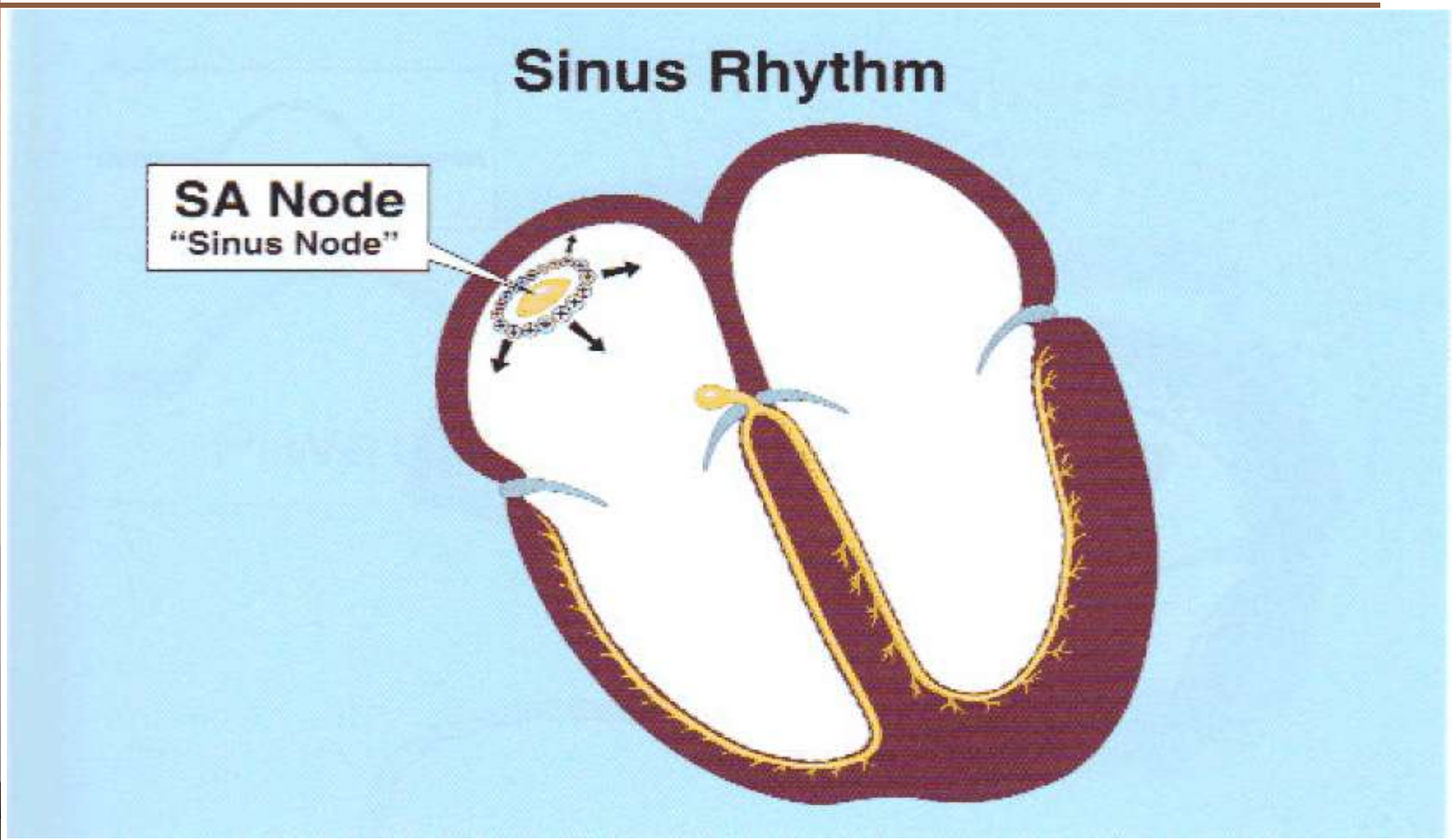
Objectives

- Describe the electrical current of the heart
- Describe the basic approach to interpretation of ECG strips
- Explain the five steps used in interpretation of ECG strips
- Explain how to calculate heart rate, PRI, and QRS complex, given a 6-second strip
- Identify different types of ECG strips pertaining to ACLS

Electrical Conduction System

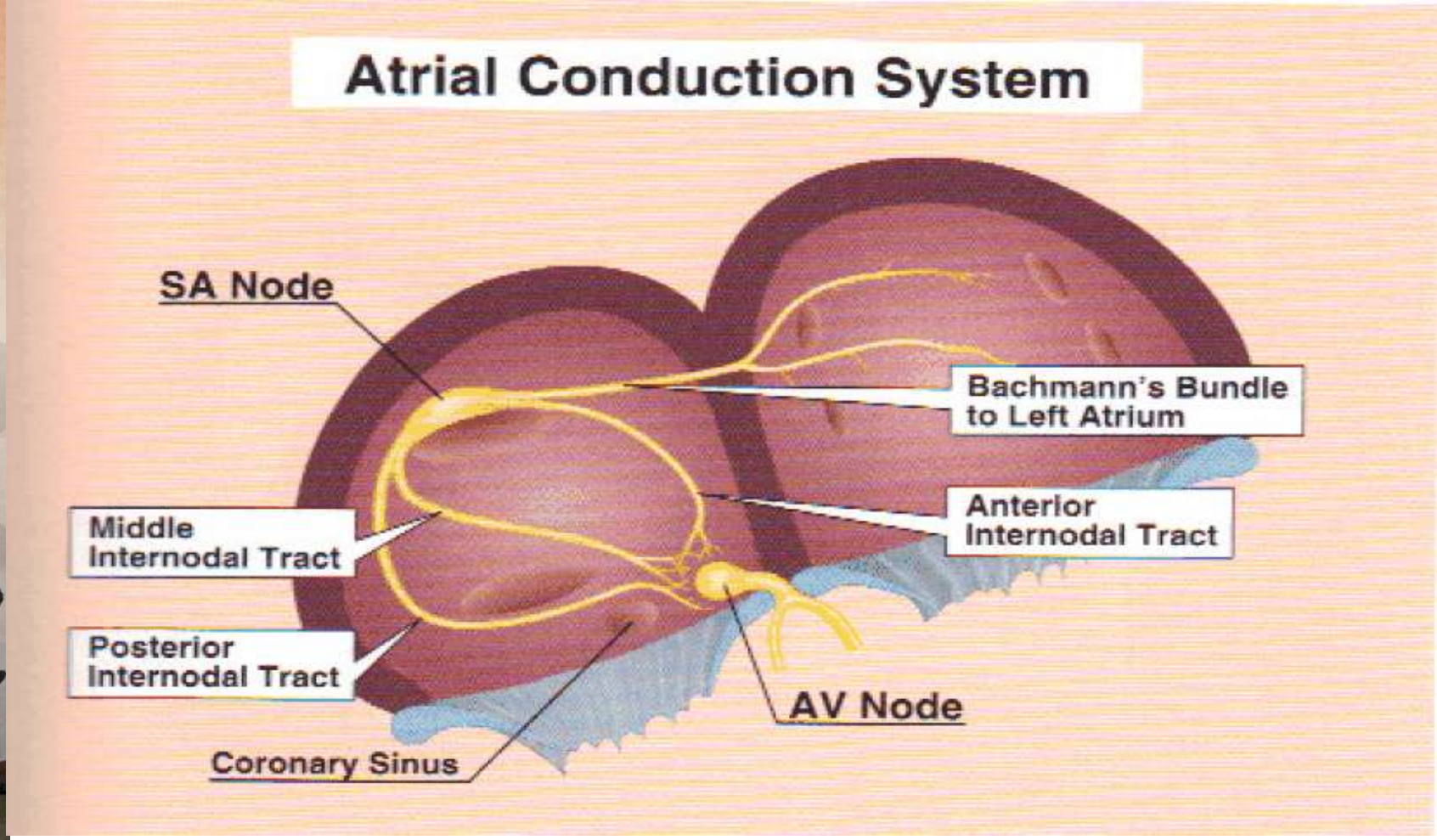


Sinus Atrial Node (SA Node)



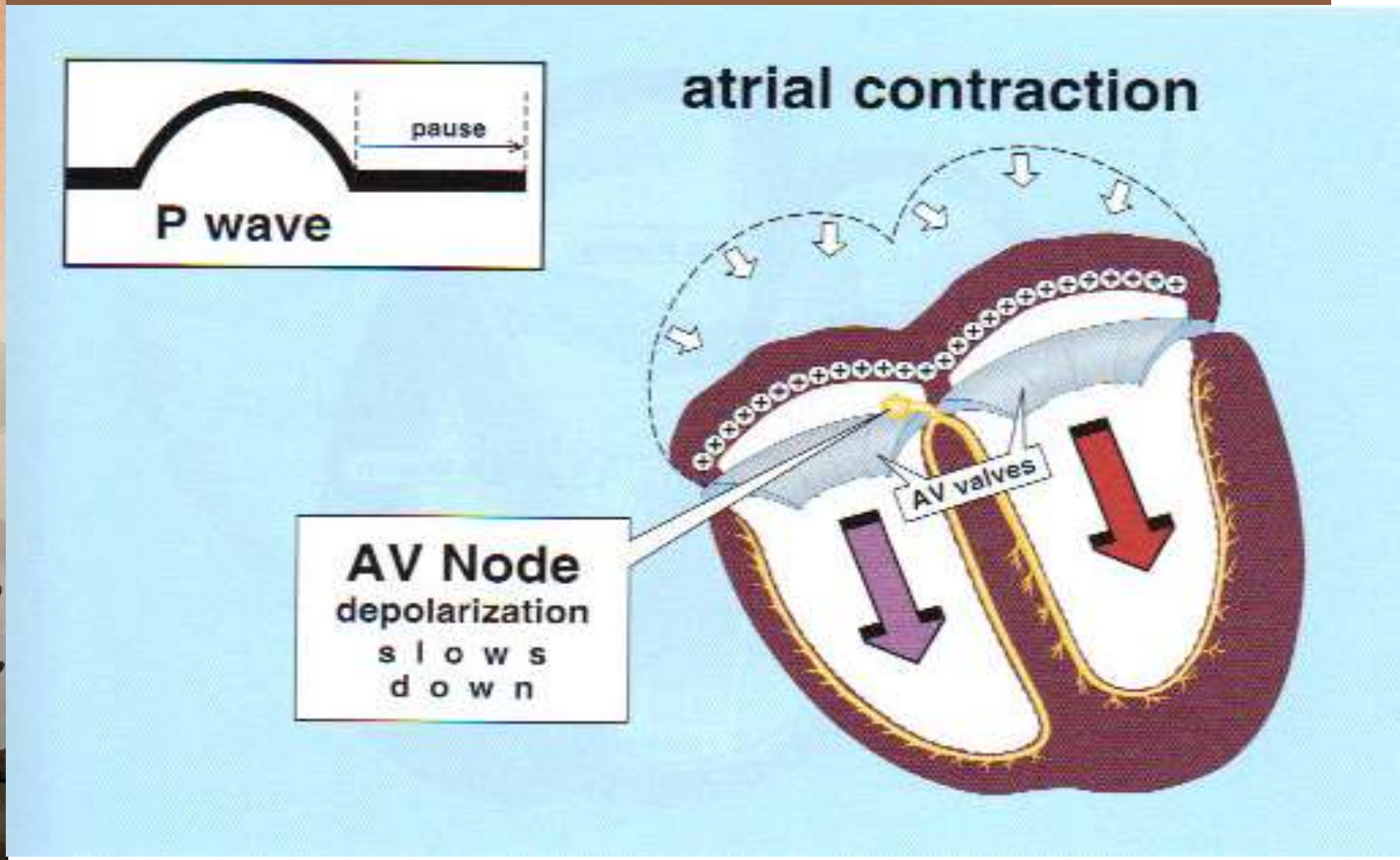
The SA node is the heart's dominant pacemaker. It initiates a wave of depolarization that spreads outward, stimulating the atria to contract as the circular wave advances. Rate 60-100

Atrial Conduction System



Consists of three specialized internodal tracts and one conduction tract known as Bachman's Bundle that innervates the left atrium.

Atrio Ventricular Node (AV Node)



When the wave of atrial depolarization enters the AV node, depolarization slows, producing a brief pause, thus allowing time for blood in the atria to enter the ventricles. AV node rate 40-60 bpm, Bundle of His rate 40-60 bpm, and Purkinje Fibers rate 20-40 bpm.

Information Obtainable from ECG Rhythm Strip Analysis

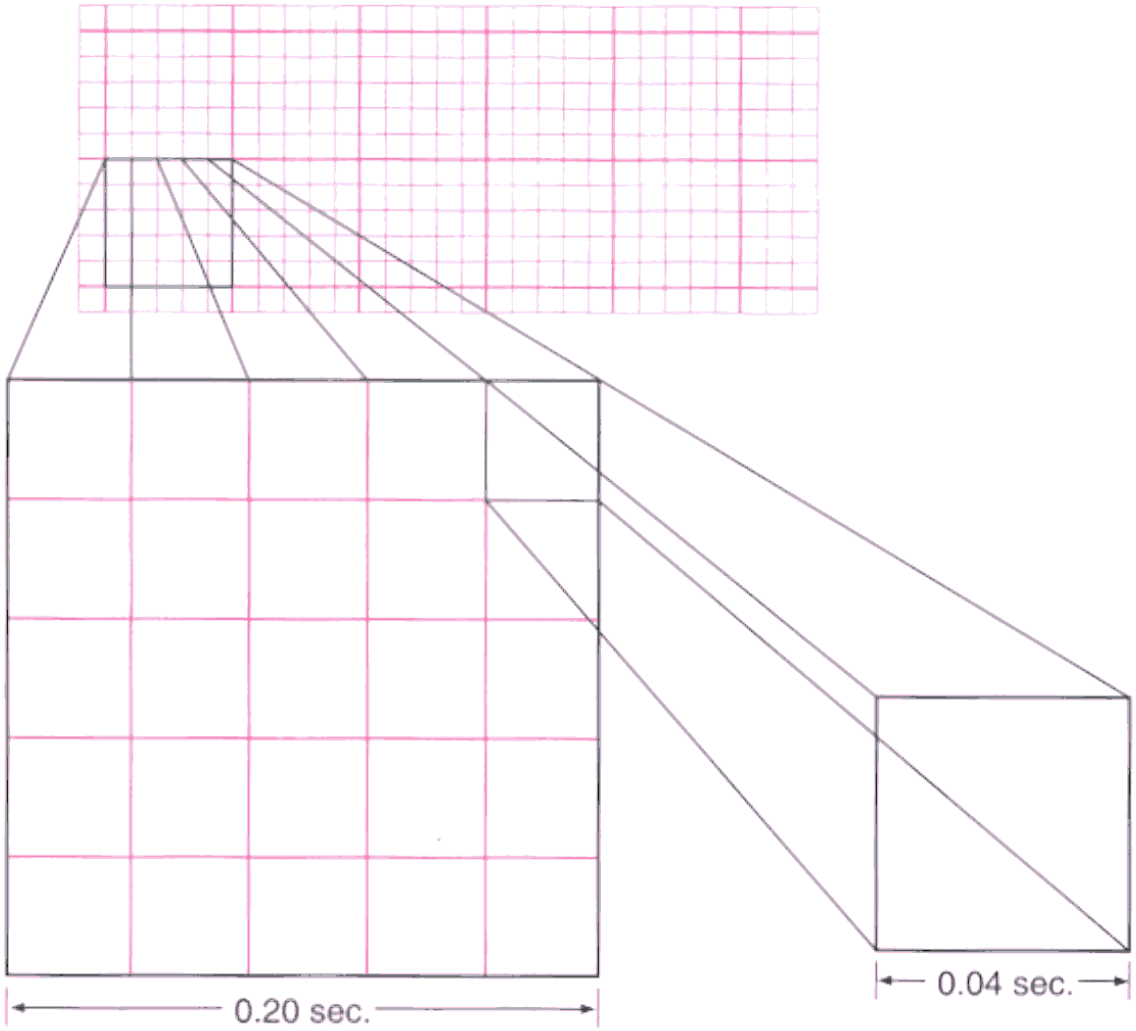
TABLE 5-1 INFORMATION OBTAINABLE FROM EKG RHYTHM STRIP ANALYSIS

Heart rate	YES	
Rhythm/regularity	YES	
Impulse conduction time intervals	YES	
Abnormal conduction pathways	YES	
Pumping action		NO
Cardiac output		NO
Blood pressure		NO
Cardiac muscle hypertrophy		NO

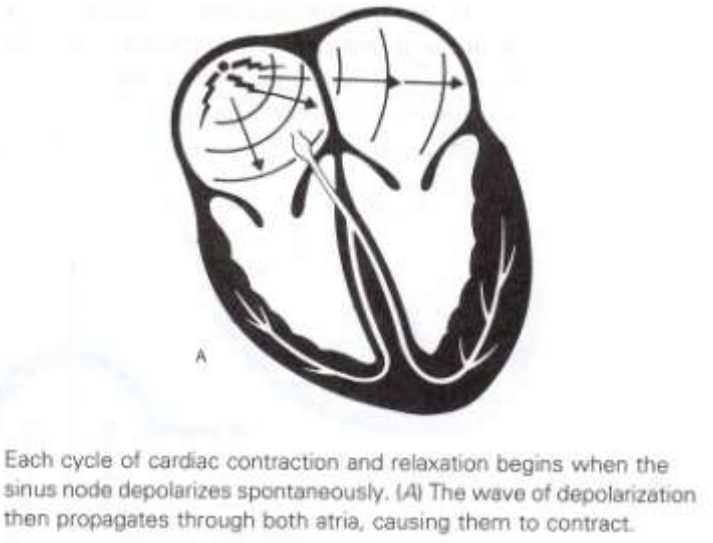
The Electrocardiogram

- Defines the graphic representation of the electrical activity of the heart
- The printed record of the electrical activity of the heart is called a rhythm strip or an ECG strip.

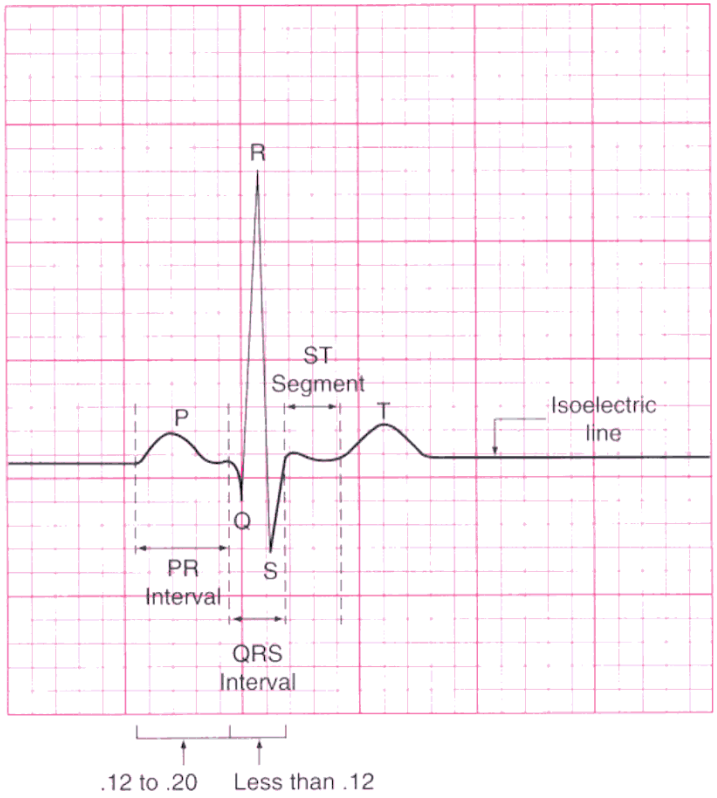
Breakdown of an ECG



"P" Wave



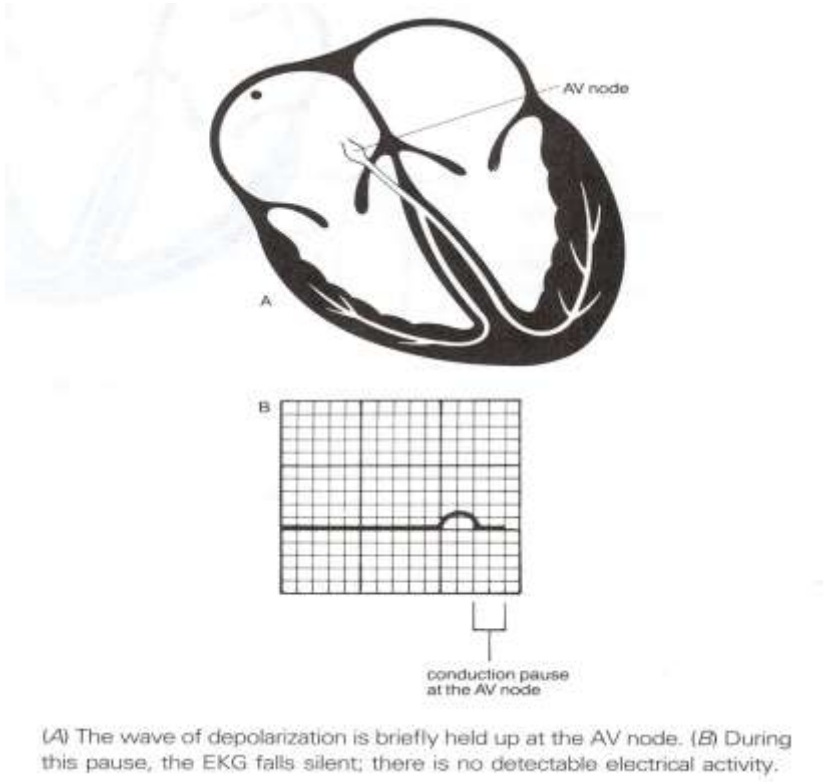
Each cycle of cardiac contraction and relaxation begins when the sinus node depolarizes spontaneously. (A) The wave of depolarization then propagates through both atria, causing them to contract.



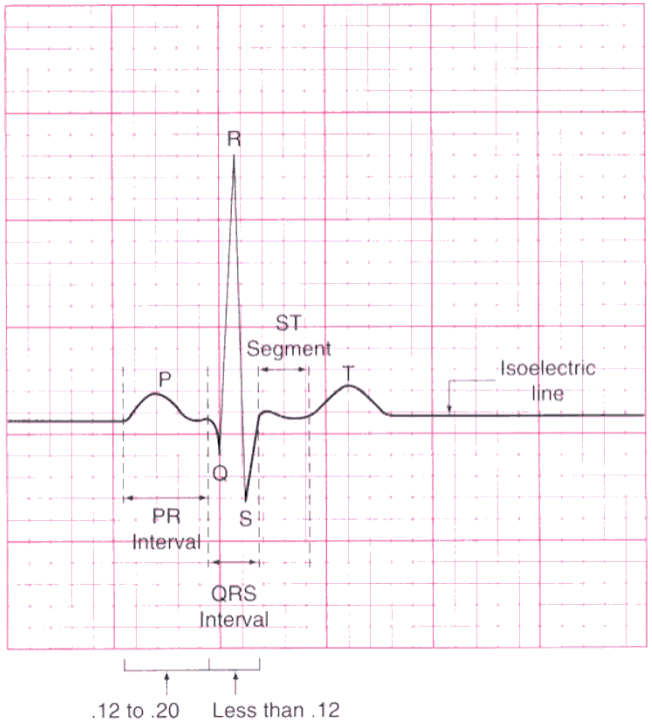
- P-Wave

  SA node fires, sends the electrical impulse outward to stimulate both atria and manifests as a P-wave. Approximately 0.10 seconds in length

"PR-Interval"

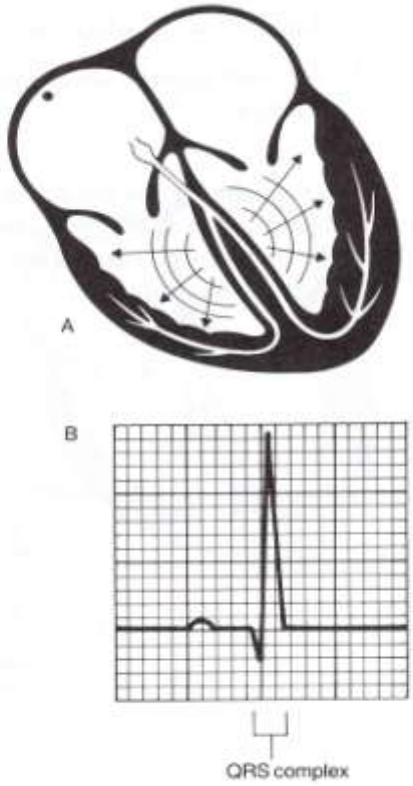


(*A*) The wave of depolarization is briefly held up at the AV node. (*B*) During this pause, the EKG falls silent; there is no detectable electrical activity.

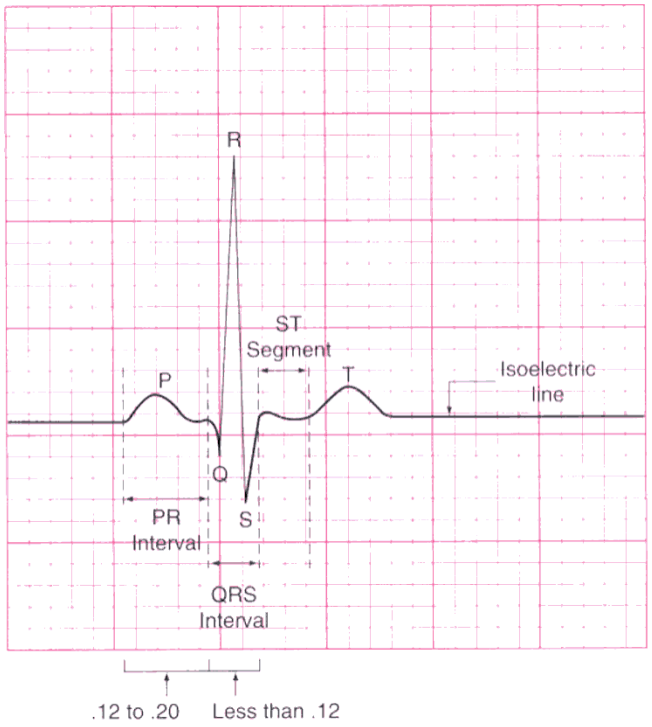


- Time which impulse travels from the SA node to the atria and downward to the ventricles

"QRS Complex"



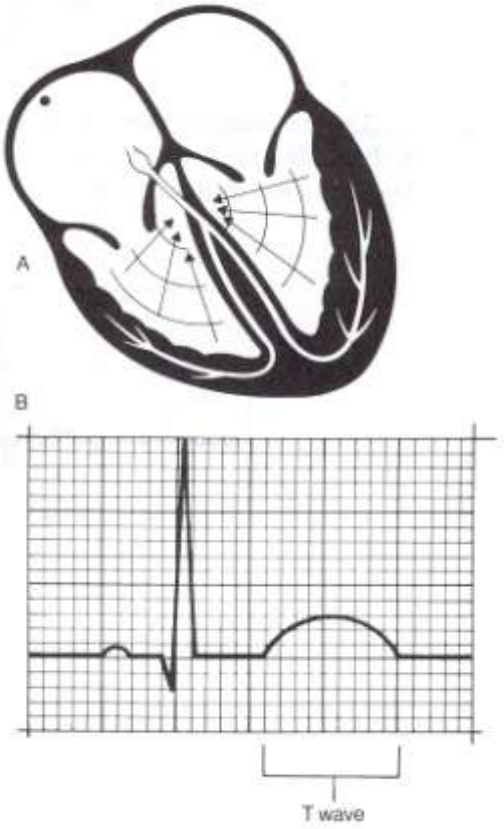
(*A*) Ventricular depolarization generates (*B*) a complicated waveform on the EKG called the QRS complex.



- QRS complex represents ventricular contraction. Lasting in duration from 0.08 – 0.12 seconds.

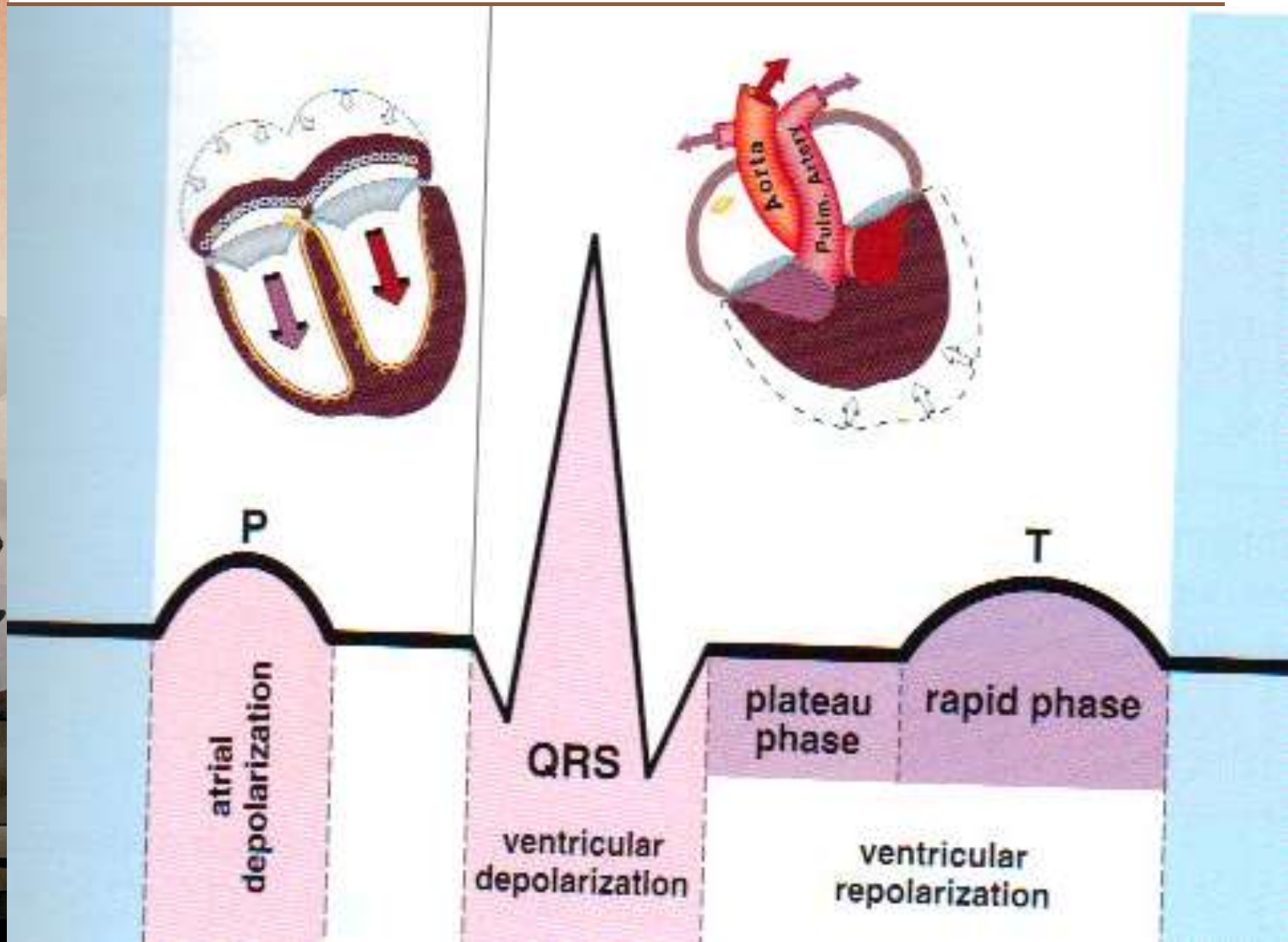
"T" Wave

- T-Wave:
  - After the myocardial cells depolarize, they resist stimulation. They then repolarize. The restore the electron negativity so they can be restimulated.
  - Resting phase of the cardiac cycle.
  - There is an atrial repolarization but it coincides with the ventricular and is hidden by the ORS complex.



(A) Ventricular repolarization generates (B) T wave on the EKG.

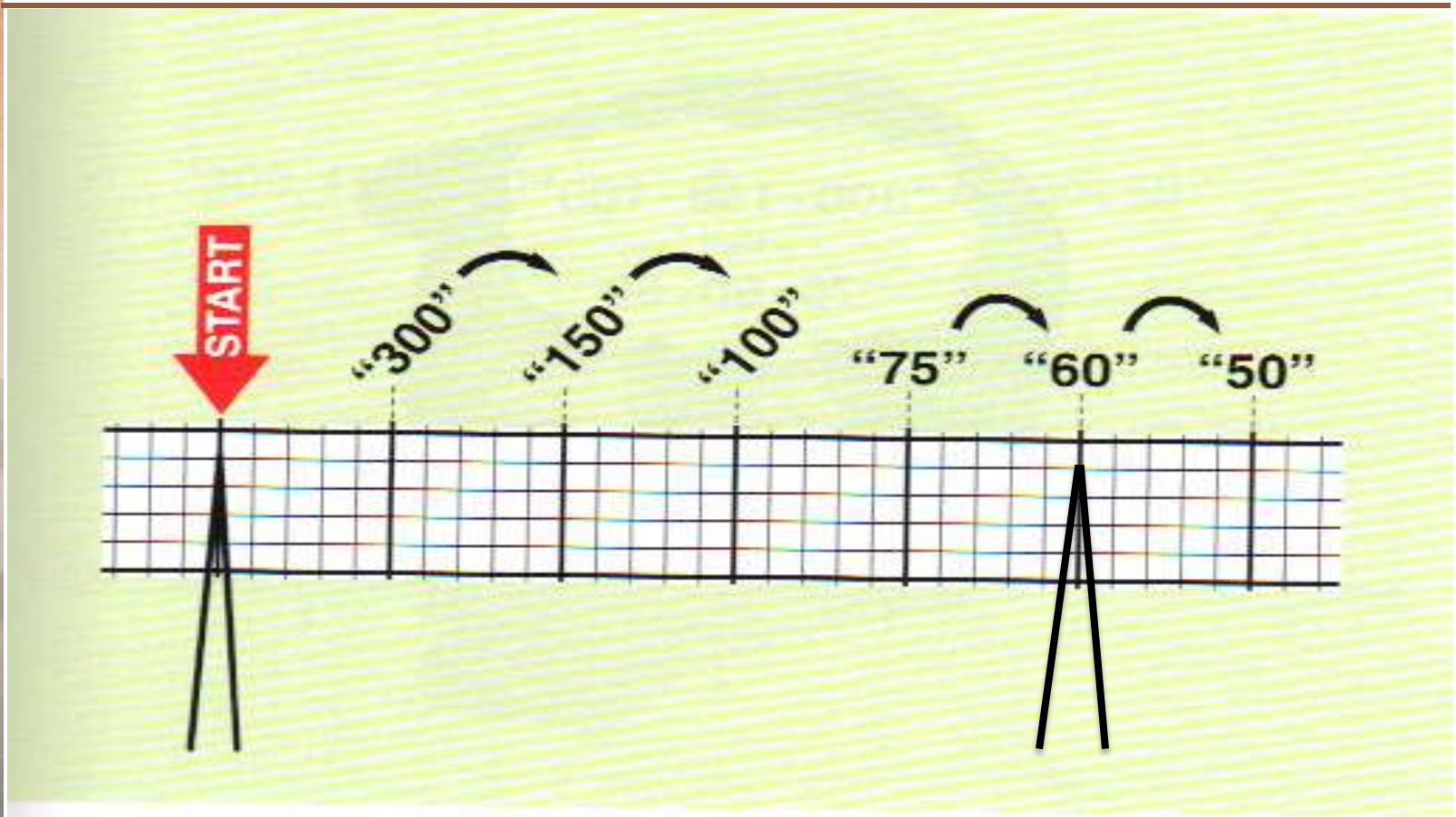
Putting it all together



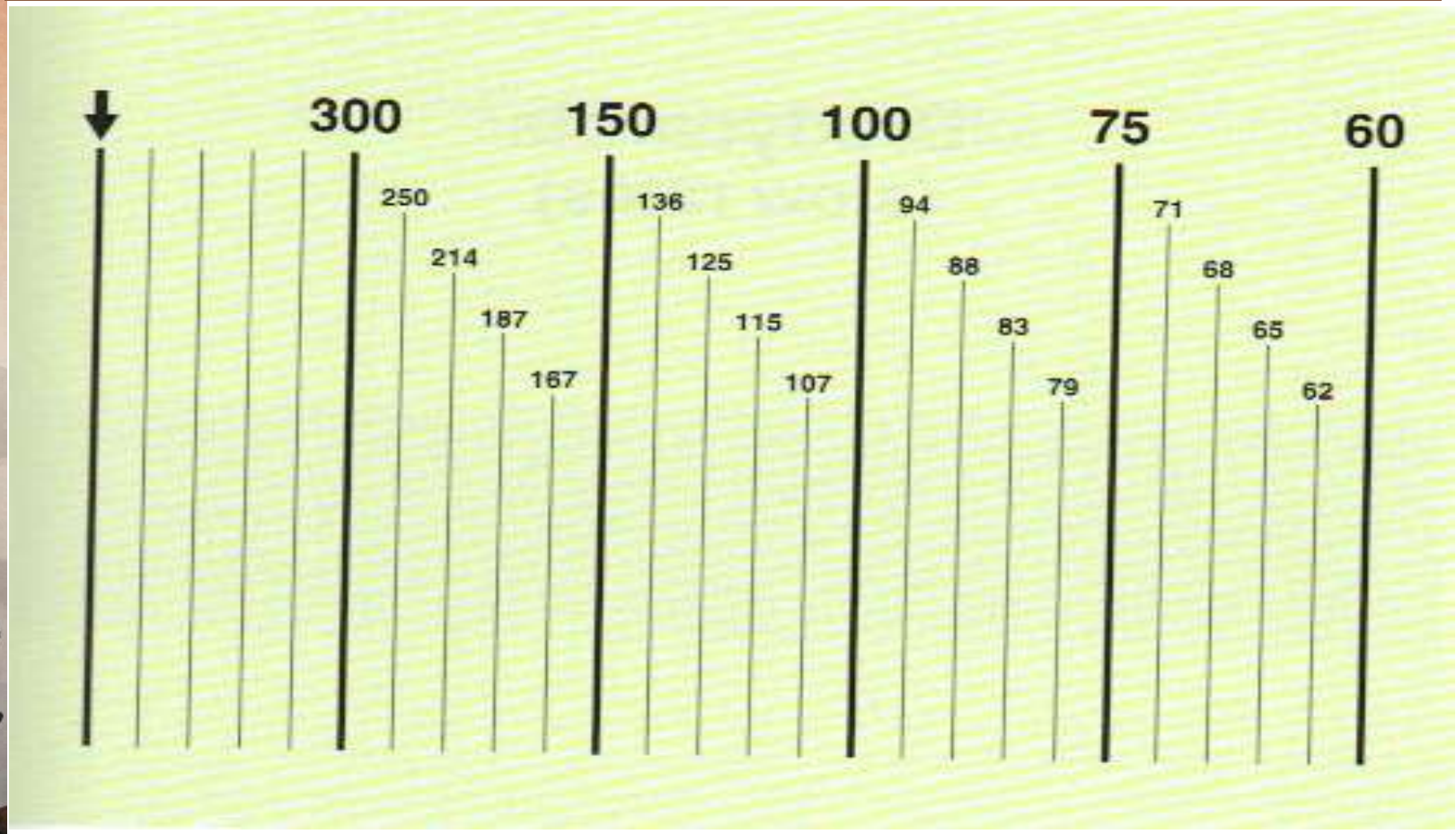
Interpretation of an ECG Strip

- Step 1: Heart Rate
- Step 2: Heart Rhythm
- Step 3: P-Wave
- Step 4: PRI
- Step 5: QRS Complex

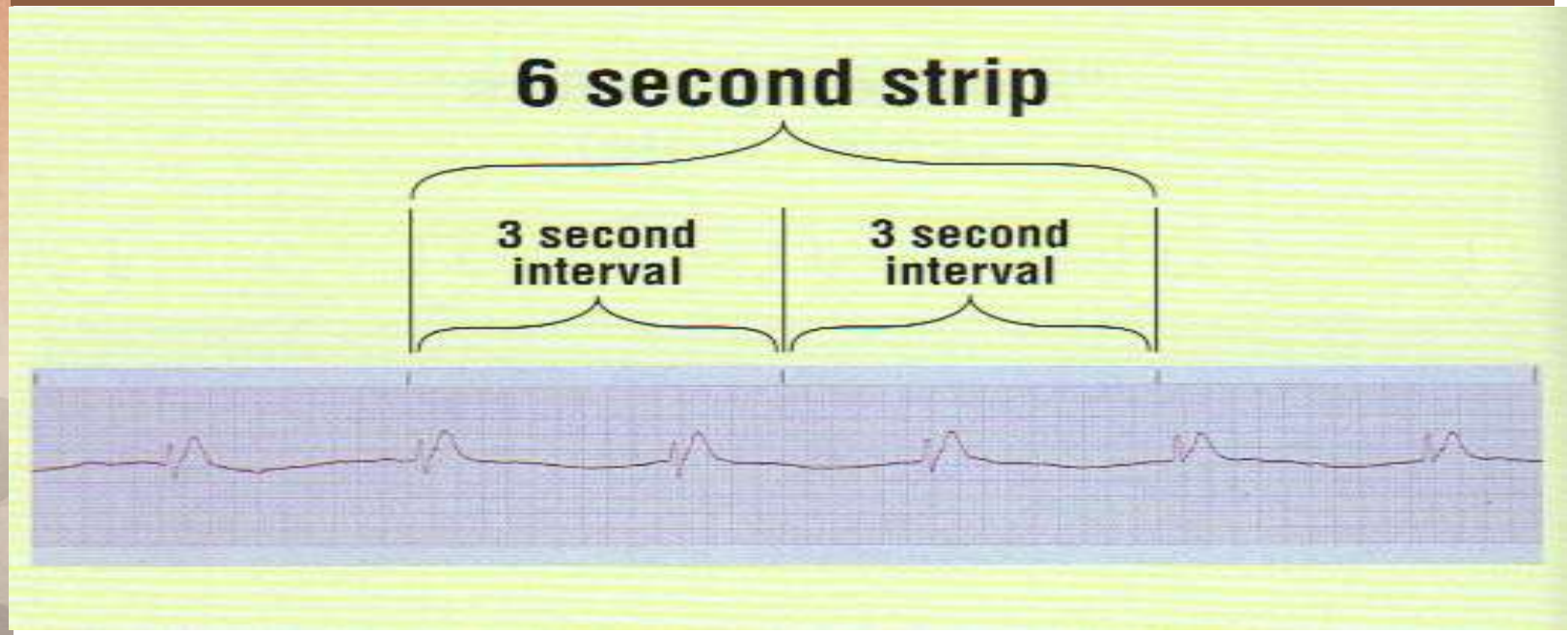
Determining the Rate Using Triplets



Detailed Break Down of Triplets



Calculating The Rate using The 6 Second Method



To calculate the rate using the six second method count the R to R waves then multiply by 10. This method is commonly used for bradycardia rates.

Check On Learning

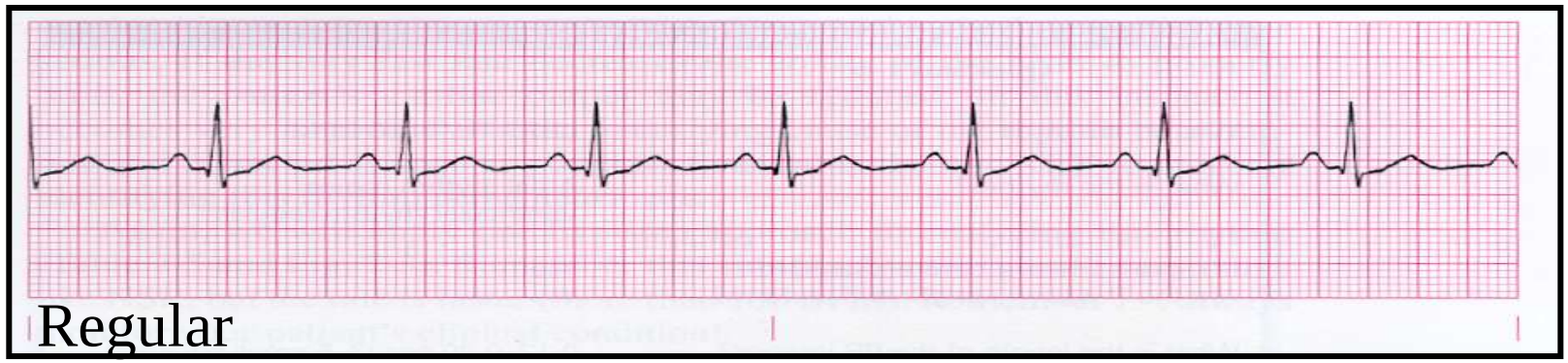
What is the rate on this rhythm strip

100 beats per minute

Heart Rhythm

- Heart rhythms are classified as regular, regularly irregular, or irregularly irregular.
- Can calculate the heart rhythm involves establishing a pattern of QRS complexes occurrence.
- Measure ventricular rhythm by measuring the interval between R-to-R waves.
- Interval > than 0.06 seconds, consider it irregular.

Rhythm Examples



Regular

Regularly Irregular

Irregularly Irregular

The P-Wave

- 5 questions:
  - 1. Are P-Waves present?
  - 2. Are P-Waves occurring regularly?
  - 3. Is there a P-Wave for each QRS complex?
  - 4. Are the P-Waves smooth, rounded, and upright in appearance?
  - 5. Do all P-Waves look similar?

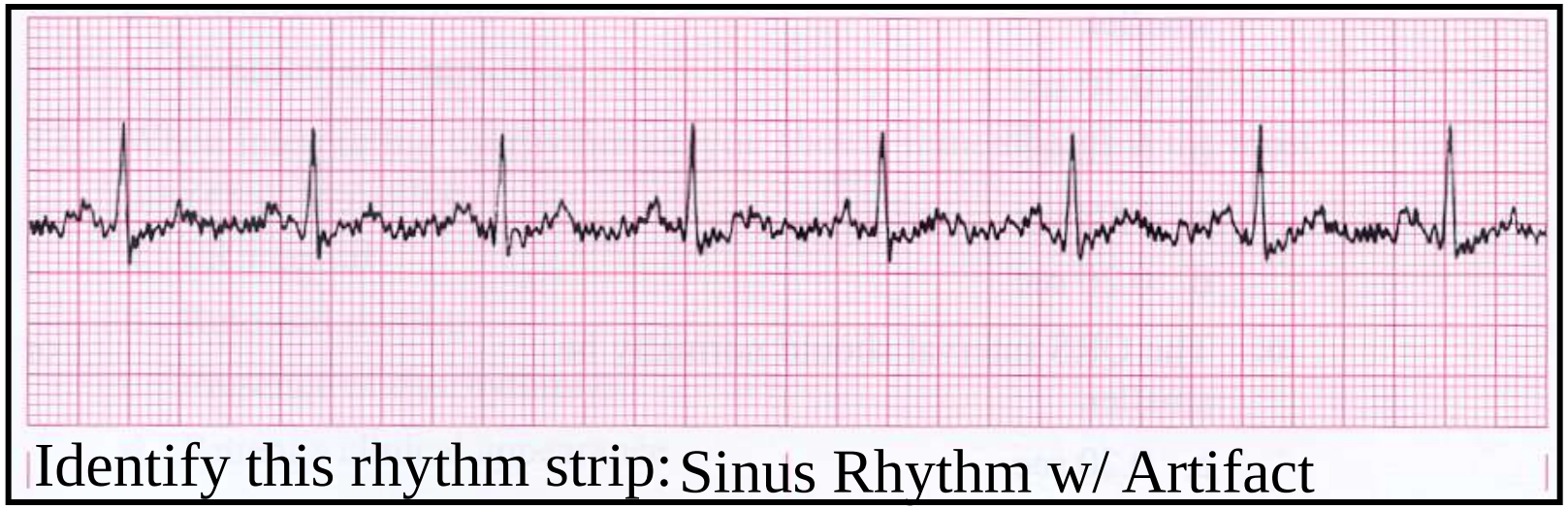
The PR-Interval

- Normal length of the PR-Interval is 0.12 to 0.20 second (3-5 small squares)
- 3 Questions to ask:
  - 1. Is the PR-Interval greater that 0.20 seconds?
  - 2. Is the PR-Interval less than 0.12 seconds?
  - 3. Is the PR-Interval constant across the ECG strip?

The QRS Complex

- 3 questions to ask:
  - 1. Are the QRS intervals greater than 0.12 second (wide)? If so, the complex may be ventricular in origin.
  - 2. Are the QRS intervals less than 0.12 seconds (narrow)? If so, the complex is most likely supraventricular in origin.
  - 3. Are the QRS complexes similar in appearance across the ECG strip?

Check On Learning



Identify this rhythm strip: Sinus Rhythm w/ Artifact

- Step 1: Heart Rate: 80bpm
- Step 2: Heart Rhythm: Regular
- Step 3: P-Wave: Yes
- Step 4: PRI: .16
- Step 5: QRS Complex: .08

Artifact

- Four Common Causes:
  - Patient Movement
  - Loose or defective electrodes
  - Improper grounding
  - Faulty ECG apparatus
- Patient assessment is critical

- **Enough playing!**

Types of Rhythms

- Rate:
  - Bradycardia = rate of <60 bpm
  - Normal = rate of 60-100 bpm
  - Tachycardia = rate of >100-160 bpm

- Where its coming from:
  - Sinus; SA node
  - Atrial; SA node fails, impulse comes from the atria (internodal or the AV node)
  - Ventricular; SA node or AV junction fails, ventricles will shoulder responsibility of pacing the heart

Sinus Rhythms

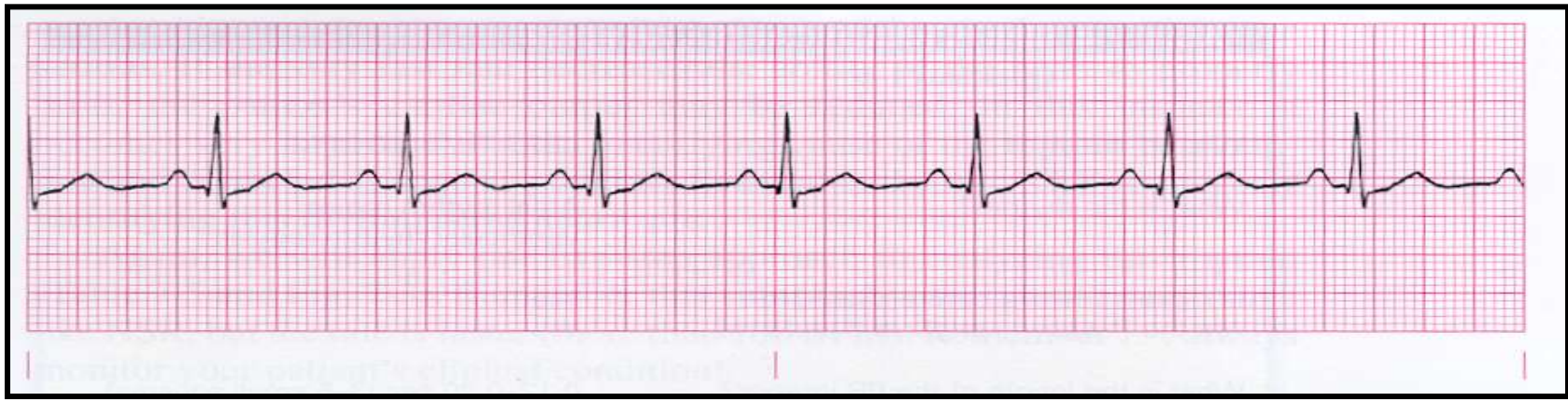
- Normal Sinus Rhythm (NSR)
- Sinus Bradycardia
- Sinus Tachycardia

Normal Sinus Rhythm (NSR)

TABLE 7-3 NORMAL SINUS RHYTHM

Question 1–5

What is the rate?	60–100 BPM
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS?	Yes
Are the P waves upright and uniform?	Yes
What is the length of the PR interval?	0.12–0.20 sec (3–5 small squares)
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is . . . ?	Less than 0.12 sec (3 small squares)

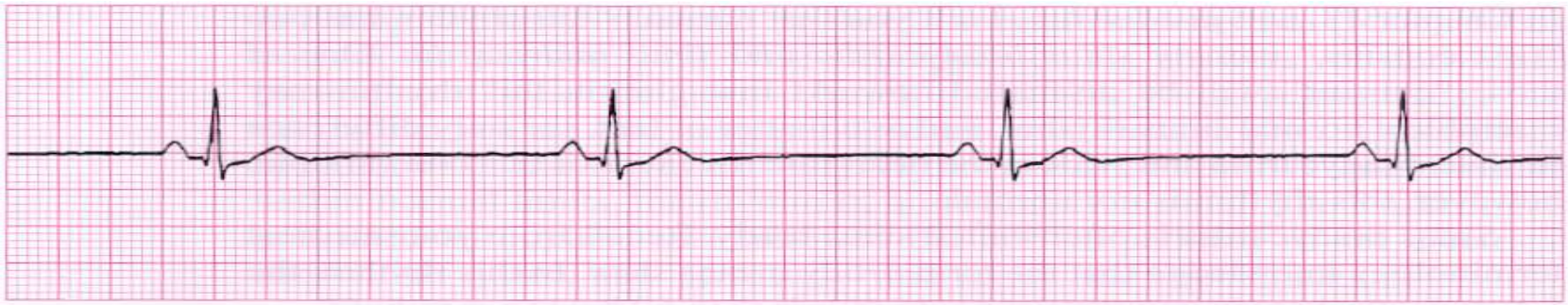


Sinus Bradycardia Rhythm

TABLE 7-4 SINUS BRADYCARDIA RHYTHM

Questions 1–5

What is the rate?	LESS THAN 60 BPM
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Yes Yes
What is the length of the PR interval?	0.12–0.20 sec (3–5 small squares)
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Less than 0.12 sec (3 small squares)



Sinus Tachycardia Rhythm

TABLE 7-5 SINUS TACHYCARDIA RHYTHM

Questions 1–5

What is the rate?	100–160 BPM
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS?	Yes
Are the P waves upright and uniform?	Yes
What is the length of the PR interval?	0.12–0.20 sec (3–5 small squares)
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is . . . ?	Less than 0.12 sec (3 small squares)

Atrial Rhythms

- SA node fails to generate an impulse, the atrial tissue or areas in the internodal pathways may initiate an impulse.
- These are called Atrial Dysrhythmias
- Generally not considered life-threatening or lethal. Careful and deliberate patient assessment must be continuous.

Types of Atrial Rhythms

- Atrial Flutter
- Atrial Fibrillation
- Supraventricular Tachycardia

Atrial Flutter

TABLE 8-3 ATRIAL FLUTTER

Questions 1–5

What is the rate?	Atrial—250–300 BPM Ventricular—variable
What is the rhythm?	Atrial—regular Ventricular—regular or irregular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Normal P waves are absent; replaced by F waves (sawtooth)
What is the length of the PR interval?	Not measurable
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is?	Usually less than 0.12 sec (3 small squares)

Atrial Fibrillation

TABLE 8-4 ATRIAL FIBRILLATION

Questions 1–5

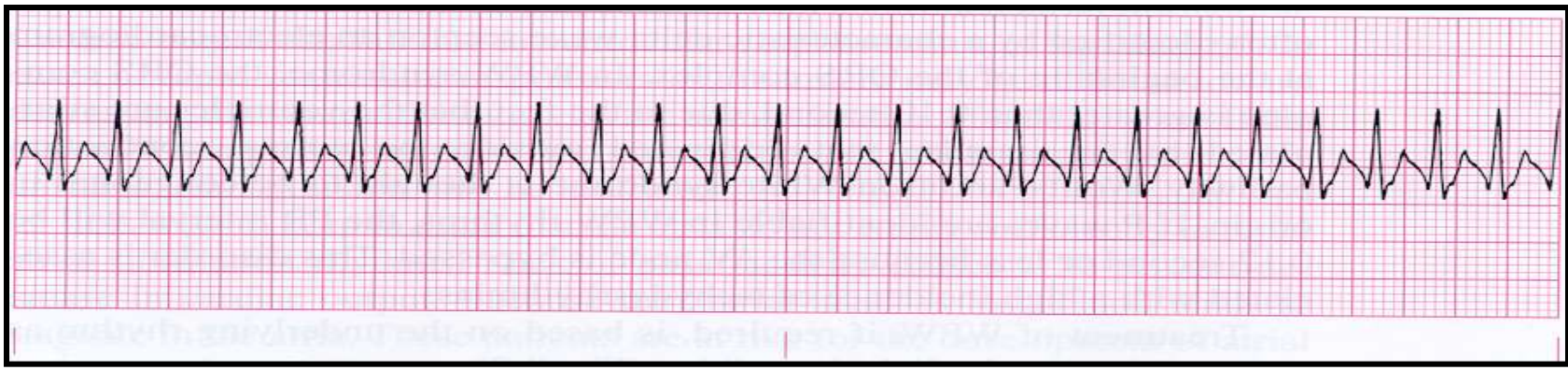
What is the rate?	Atrial—350–400 BPM Ventricular—variable
What is the rhythm?	Irregularly irregular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Normal P waves are absent; replaced by f waves
What is the length of the PR interval?	Not discernable
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Usually less than 0.12 sec

Supraventricular Tachycardia

TABLE 8-5 SUPRAVENTRICULAR TACHYCARDIA

Questions 1–5

What is the rate?	Atrial—150–250 BPM Ventricular—150–250 BPM
What is the rhythm?	Regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Usually not discernable, especially at the high-rate range
What is the length of the PR interval?	Usually not discernable
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Usually less than 0.12 sec



Ventricular Rhythms

- SA node or the AV junctional tissue fails to initiate an electrical impulse, the ventricles will shoulder the responsibility of pacing the heart.
- This group of rhythms are called Ventricular Dysrhythmias.
- An electrical impulse can be instigated from any pacemaker cell in the ventricles, including the bundle branches or the Purkinje fibers.

Types of Ventricular Rhythms

- Premature Ventricular Complexes
- Ventricular Tachycardia
- Torsades de Pointes
- Ventricular Fibrillation
- Asystole
- Pulseless Electrical Activity (PEA)

Premature Ventricular Complexes (PVCs)

TABLE 10-3 PREMATURE VENTRICULAR COMPLEXES

Questions 1–5

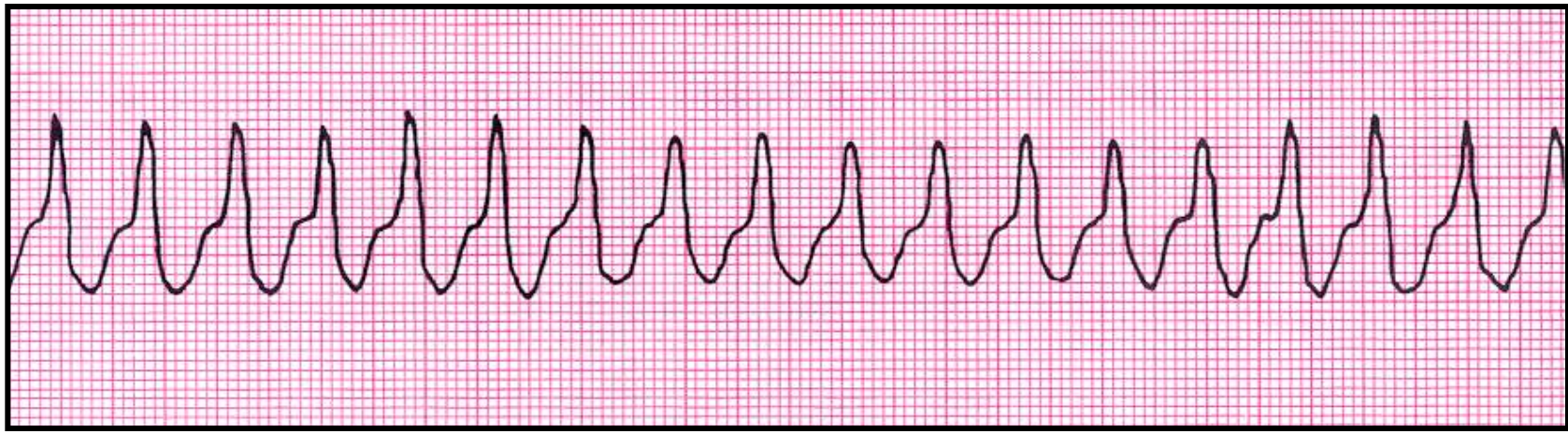
What is the rate?	Dependent on rate of underlying rhythm and number of PVCs
What is the rhythm?	Occasionally irregular; regular if interpolated PVC
Is there a P wave before each QRS? Are the P waves upright and uniform?	No P waves associated with PVC; P waves of underlying rhythm may be present
What is the length of the PR interval?	PRI not present with PVCs
The length of the QRS complexes is . . . ? What do the QRS complexes look like?	Greater than or equal to 0.12 sec (3 small squares); usually wide and bizarre

Ventricular Tachycardia

TABLE 10-5 VENTRICULAR TACHYCARDIA RHYTHM

Questions 1–5

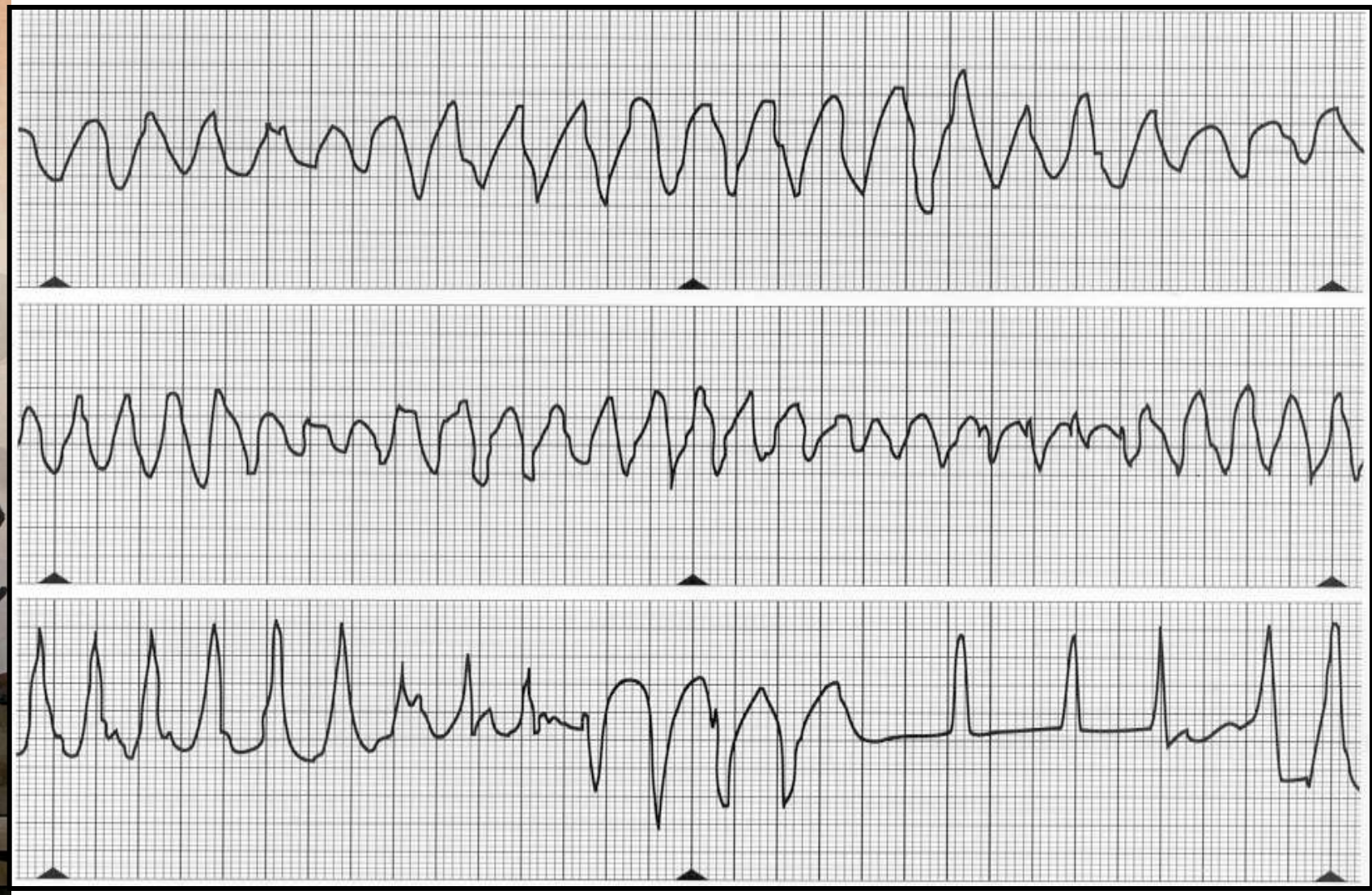
What is the rate?	100–250 BPM
What is the rhythm?	Atrial rhythm not distinguishable Ventricular rhythm usually regular
Is there a P wave before each QRS?	May be present or absent; not associated with QRS complexes
What is the length of the PR interval?	None
Do all the QRS complexes look alike?	Yes (except in torsades rhythm); bizarre QRS morphology
The length of the QRS complexes is . . . ?	Greater than 0.12 sec



Torsades de Pointes

- French term that signifies the “twisting of the points”.
- May wax and wane in amplitude and may “flip” or “twist” on its electrical axes.
- Similar to ventricular tachycardia
- Caused by hypomagnesaemia or by antiarrhythmic drugs

Torsades de Pointes



Ventricular Fibrillation

TABLE 10-6 VENTRICULAR FIBRILLATION

Questions 1–5

What is the rate?	Rate cannot be discerned
What is the rhythm?	Rapid, unorganized Rhythm not distinguishable
Is there a P wave before each QRS?	No
What is the length of the PR interval?	None present
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	None present

Asystole

TABLE 10-7 VENTRICULAR ASYSTOLE

Questions 1–5

What is the rate?	Absent
What is the rhythm?	Absent Rhythm not distinguishable
Is there a P wave before each QRS?	No
What is the length of the PR interval?	None present
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	None present

Pulseless Electrical Activity (PEA)

- The absence of a palpable pulse and myocardial muscle activity with the presence of organized electrical activity (excluding VT and VF) on cardiac monitor.

- It is **not** an actual rhythm, it represents a clinical condition wherein the patient is clinically dead, despite the fact that some type of organized rhythm appears on the monitor.

Types of Heart Blocks

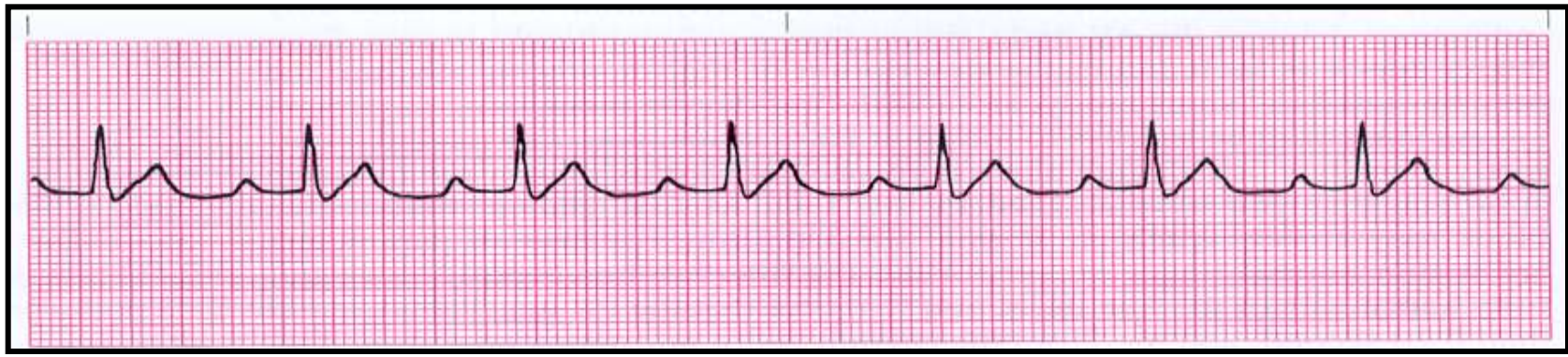
- First Degree AV Block
- Second-Degree AV Block (Mobitz Type I) or Wenckebach
- Second-Degree AV Block (Mobitz Type II)
- Third Degree AV Block (Complete)

First Degree AV Block

TABLE 11-1 FIRST-DEGREE AV BLOCK

Questions 1–5

What is the rate?	Based on the rate of the underlying rhythm
What is the rhythm?	Usually regular
Is there a P wave before each QRS?	Yes
Are the P waves upright and uniform?	Yes
What is the length of the PR interval?	Greater than 0.20 sec (5 small squares)
Do all the QRS complexes look alike?	Yes
The length of the QRS complexes is . . . ?	Less than 0.12 sec (3 small squares)



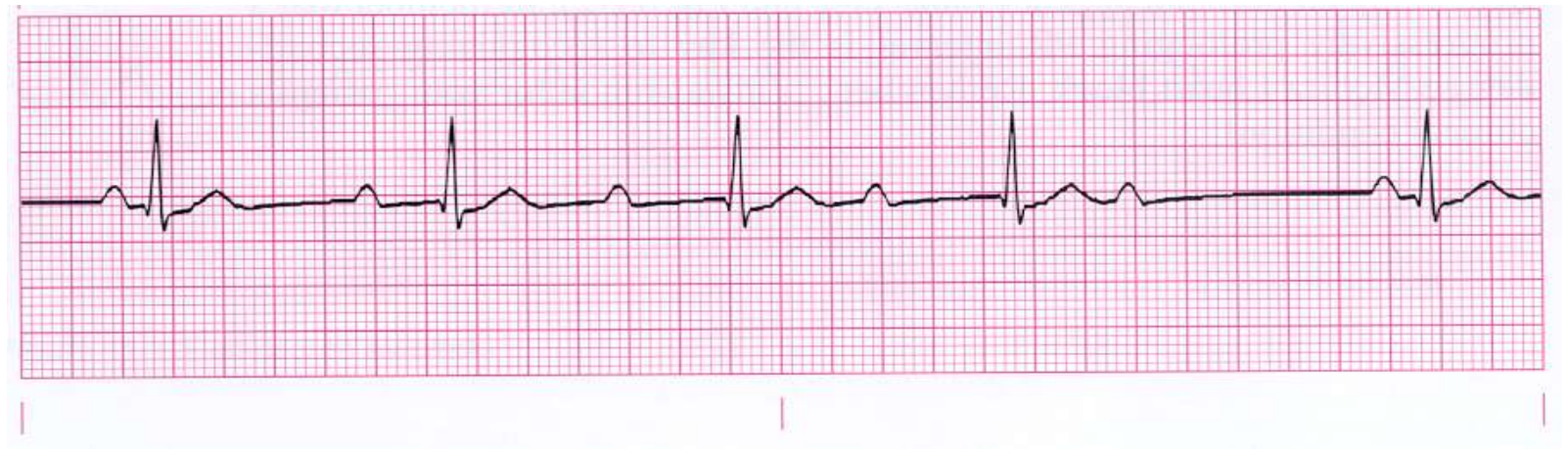
Second-Degree AV Block (Mobitz Type I) or Wenckebach

TABLE 11-2 SECOND-DEGREE BLOCK, MOBITZ TYPE I

Questions 1–5

What is the rate?	Atrial unaffected Ventricular rate is usually slower than atrial
What is the rhythm?	Atrial rhythm regular Ventricular rhythm irregular
Is there a P wave before each QRS? Are the P waves upright and uniform?	Yes Yes, for conducted beats
What is the length of the PR interval?	Progressively prolongs until a QRS is not conducted
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Less than 0.12 sec

Second-Degree AV Block (Mobitz Type I) or Wenckebach



Second-Degree AV Block (Mobitz Type II)

TABLE 11-3 SECOND-DEGREE BLOCK, TYPE MOBITZ II

Questions 1–5

What is the rate?	Atrial rate regular Ventricular rate may be bradycardic
What is the rhythm?	Atrial rhythm regular Ventricular rhythm irregular
Is there a P wave before each QRS?	Yes; some P waves are not followed by a QRS complex
Are the P waves upright and uniform?	P waves are usually upright and uniform
What is the length of the PR interval?	Constant for conducted beats
Do all the QRS complexes look alike?	Yes; intermittently absent
The length of the QRS complexes is . . . ?	Greater than or equal to 0.12 sec

Third Degree AV Block (Complete)

TABLE 11-4 THIRD-DEGREE (COMPLETE) HEART BLOCK

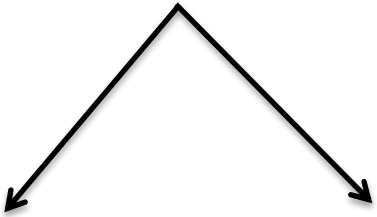
Questions 1–5

What is the rate?	Atrial rate usually 60 to 100 BPM Ventricular rate based on site of escape pacemaker
What is the rhythm?	Atrial rhythm regular Ventricular rhythm regular
Is there a P wave before each QRS? Are the P waves upright and uniform?	No relationship to QRS complexes Yes
What is the length of the PR interval?	Totally variable; no pattern
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Yes Based on site of escape pacemaker

Third Degree AV Block (Complete)

Heart Blocks Made Easy

- Is the PR-Interval that is associated with a QRS complex constant:



Yes

2nd Degree Type II

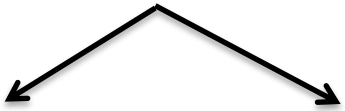
No

2nd Degree Type I

Or

3rd Degree

- Is the R to R constant:



Yes

3rd Degree

No

2nd Degree Type I

Artificial Pacemaker

TABLE 12-1 ARTIFICIAL PACEMAKER RHYTHM

Questions 1–5

What is the rate?	Varies according to preset rate of pacemaker (usually 70 BPM)
What is the rhythm?	Regular if pacing is fixed, irregular if demand-paced
Is there a P wave before each QRS? Are the P waves upright and uniform?	May be absent or present, based on type of artificial pacemaker
What is the length of the PR interval?	Variable, depending on type of artificial pacemaker
Do all the QRS complexes look alike? The length of the QRS complexes is . . . ?	Usually; greater than or equal to 0.12 sec; bizarre morphology; presence of spikes

Practice Strips

Atrial Fibrillation with PVC's

NSR

Sinus Bradycardia

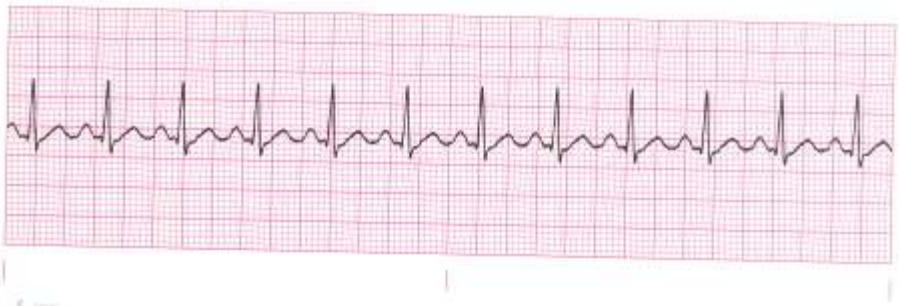
Practice Strips

Ventricular Fibrillation
Or Torsades

Third-Degree Heart Block

Asystole

Practice Strips



Sinus Tachycardia

Second-Degree AV Block
Mobitz Type I,
Wenckebach

Atrial Flutter

Summary

- Describe the electrical current of the heart
- Describe the basic approach to interpretation of ECG strips
- Explain the five steps used in interpretation of ECG strips
- Explain how to calculate heart rate, PRI, and QRS complex, given a 6-second strip
- Identify different types of ECG strips pertaining to ACLS

Questions/Confused

Your Brain